



NWS/West Coast and Alaska Tsunami Warning Center

Frequently Asked Questions

Last updated: 3/2005

What is a tsunami?

- A tsunami is a series of waves with a long wavelength and period (time between crests) generated by a large, impulsive displacement of sea water.
- Time between crests of the wave can vary from a few minutes to over an hour.
- Tsunamis are often incorrectly called tidal waves; they have no relation to the daily ocean tides.

How are tsunamis generated?

- Tsunamis are generated by any large, impulsive displacement of the sea level.
- Earthquakes which produce horizontal sea floor motion will generate little to no tsunami.
- Tsunamis are also triggered by landslides into or under the water surface, and can be generated by volcanic activity and meteorite impacts.

How often do tsunamis occur?

- On the average, two tsunamis occur per year throughout the world which inflict damage near the source.
- Approximately every 15 years a destructive, ocean-wide tsunami occurs.

What does the word “tsunami” mean?

- Tsunami (soo-NAH-mee) is a Japanese word meaning harbor wave.

How fast do tsunamis travel?

- Tsunami velocity depends on the depth of water through which it travels (velocity equals the square root of the product of the water depth times the acceleration of gravity).
- Tsunamis travel approximately 475 mph in 15,000 feet of water. In 100 feet of water the velocity drops to about 40 mph.
- A tsunami travels from the central Aleutian Is. to Hawaii in about 5 hours and to California in about 6 hours, or from the Portugal coast to North Carolina in about 8.5 hours.

How big is a tsunami?

- Tsunamis range in size from inches to over a hundred feet.
- In deep water (greater than 600 feet), tsunamis are rarely over 3 feet and will not be noticed by ships due to their long period (time between crests).

- As tsunamis propagate into shallow water, the wave height can increase by over 10 times.
- Tsunami heights vary greatly along a coast. The waves can be amplified by shoreline and bathymetric (sea floor) features.
- A large tsunami can flood low-lying coastal land over a mile from the coast.

What does a tsunami look like when it reaches shore?

- Normally, a tsunami appears as a rapidly advancing or receding tide.
- In some cases a bore (wall of water) or series of breaking waves may form.

How is a tsunami different from a wind-generated wave?

- Wind-generated waves usually have periods (time between crests) between 5 and 15 seconds. Tsunami periods normally range from 5 to 60 minutes.
- Wind-generated waves break as they shoal and lose energy offshore. Tsunamis act more like a flooding wave. A twenty foot tsunami is a twenty foot rise in sea level.

What are the West Coast and Alaska Tsunami Warning Center's (WC/ATWC) responsibilities?

- The main mission of the WC/ATWC is to help protect life and property from tsunami hazard by providing tsunami information and warning messages to its area-of-responsibility (AOR).
- The WC/ATWC AOR is the U.S. West, Alaskan, Atlantic, and Gulf of Mexico coasts as well as the coast of British Columbia in Canada.
- Develop new processes and techniques to improve response times, accuracy, and bulletin content to residents in the AOR.
- Increase community preparedness and public tsunami education through the TsunamiReady program and outreach.
- Staff consists of six full-time personnel who provide on-site coverage during regular work hours and provide "on-call" service after hours. Two personnel are always within 5 minutes travel to the center.
- For more information on the center, see <http://wcatwc.arh.noaa.gov/subpage3.htm>.

When are warnings issued?

- Warnings are issued when a potentially tsunami-producing earthquake over the threshold magnitude (7.0 in the Pacific AOR, 6.75 in the Atlantic AOR) occurs in the AOR.
- Warnings are also issued when potentially tsunami-producing earthquakes over magnitude 7.5 occur outside the AOR and are likely to impact the AOR.
- The geographic extent of the warning is based on the size of the earthquake and tsunami travel times throughout the AOR.
- Warnings are issued within 10 minutes after earthquake occurrence.

Do all large earthquakes, greater than magnitude 7, generate tsunamis?

- No, only those which induce large vertical sea floor displacements, or those that trigger landslides which displace significant amounts of sea water, trigger tsunamis.

How does the WC/ATWC respond to landslide-generated tsunamis?

- Many landslides which generate tsunamis are triggered by large earthquakes. In this case, local warnings will be issued based on the earthquake size.
- In some cases, sub-sea landslides will occur with little to no seismic energy release (e.g., Skagway, AK 1994). Historically, these events have been locally destructive with impacts occurring within minutes. The Tsunami Warning System is not set up to respond to this type of event.

What is a tsunami warning?

- A tsunami warning indicates that a tsunami may be imminent and that coastal locations in the warned area should prepare for flooding.
- The initial warning is typically based solely on seismic information.
- After the tsunami is recorded on sea level gages, the warning will be cancelled, restricted, expanded incrementally, or expanded to cover the entire coast in the event of a major tsunami.
- Tsunami warnings include estimated wave arrival times for key coastal locations in the warned area.

What is a tsunami watch?

- A tsunami watch is an alert issued to areas outside the warned area.
- The geographical extent of the watch area is based on the size of the earthquake and tsunami travel times throughout the AOR.
- The watch will either be upgraded to a warning in subsequent bulletins or cancelled depending on the severity of the tsunami.
- Tsunami watches include estimated wave arrival times for key coastal locations in the watch area.

What are nature's signs that a tsunami may be imminent?

- Hard ground shaking for 20+ seconds near the coast.
- A sudden sea level withdrawal.
- Tsunamis may be accompanied by loud, booming noises.

Where should I go in the event of a tsunami warning or large, local earthquake?

- Know evacuation routes and potential hazard zones for your area. Most coastal communities have an evacuation plan and designated safe areas. This information can be obtained from your local emergency official.
- If the tsunami hazard zone has been delineated for your area, stay out of that area.
- If no tsunami hazard zone has been established or you don't know what it is, as a rule of thumb move to 100 feet above sea level or 1 mile inland.

- The WC/ATWC issues tsunami warnings, but the warnings and subsequent evacuations are implemented by state and local emergency management.
- Mariners in deep water should stay at sea. Those in shallow water or harbors should move to deep water if there is enough time and weather conditions are suitable.

What information does the WC/ATWC evaluate in order to issue tsunami bulletins?

- WC/ATWC acquires seismic data from various seismic networks throughout its AOR. This data is processed, automatically and interactively, to quickly determine the tsunami-potential of an earthquake.
- Bulletins are issued based initially on this first analysis of seismic data.
- If a tsunami could have been generated, sea level data and historical tsunami information are analyzed to estimate impact level.
- Based on impact estimations, supplemental bulletins are issued.

How are warnings issued?

- Warnings are broadcast through standard National Weather Service (NWS) dissemination methods such as the NOAA Weather Radio-All Hazards, the Emergency Alert System, and the Emergency Managers Weather Information Network.
- State Emergency Service Agencies receive the message through FEMA's National Warning System and the NOAA Weather Wire. The states immediately pass warnings to local jurisdictions.
- The US Coast Guard relays the message via radio.
- The warnings are posted on the WC/ATWC and NWS web sites (<http://wcatwc.arh.noaa.gov/message.shtml>) and are issued through a public e-mail list server.
- Many coastal communities supplement the basic notification systems with sirens, automatic phone messaging systems, etc. Contact your local emergency management officials to determine local procedures.

Can the WC/ATWC predict earthquakes and tsunamis?

- No, earthquakes can not be predicted.
- Once an earthquake has occurred, the arrival time of a tsunami, if generated, can be determined accurately.
- Tsunami wave heights can not be accurately predicted near the earthquake source. Away from the source, tsunami wave heights can be estimated based on mathematical tsunami models and observed wave heights.

What was the biggest earthquake ever recorded?

- The largest recorded earthquake occurred in Chile (9.5) in 1960.
- The second largest earthquake recorded was the 1964 Alaskan earthquake (9.2).
- Three of the seven largest earthquakes ever recorded occurred in Alaska.
- See <http://www.neic.cr.usgs.gov/> for more information on earthquakes

Has WC/ATWC's AOR experienced any damaging tsunamis?

- **Alaska:** Major tsunamis were generated along the Alaskan coast in 1946, 1957, 1958, 1964, and 1965. Many other locally generated tsunamis occurred prior to those dates.
- **US West Coast:** Tsunamis were generated locally in 1812, 1873, 1878, 1927, 1930, 1946 and 1949. The west coast was also impacted by tsunamis generated in other regions in 1877, 1946, 1952, 1957, 1960, 1964, and 1975.
- **US Atlantic Coast:** Tsunamis were recorded in 1755, 1884, 1886, and 1929.
- See http://wcatwc.arh.noaa.gov/web_tsus/pastaor_tsunamis.htm for more information on west coast tsunamis.
- See <http://www.ngdc.noaa.gov/seg/hazard/tsu.shtml> for the NOAA/NGDC tsunami catalog.

How are maximum expected wave heights determined for a specific location?

- In areas where the maximum potential source is known (e.g., areas with an active subduction zone offshore), tsunami generation, propagation, and runup can be mathematically modeled and maximum wave heights estimated. Or, if the area's largest expected earthquake has occurred in recorded times, the historical records can be used to constrain expectations.
- In areas where the maximum potential source is unknown and no historic events have occurred (e.g., parts of the U.S. Atlantic coast), maximum expected wave height is difficult to determine. Many potential sources must be considered to determine the maximum expectations.
- The National Tsunami Hazard Mitigation Program (<http://www.pmel.noaa.gov/tsunami-hazard/>) has funded hazard assessment investigations for many west coast, Alaska, and Hawaii communities. The process will be extended to the Atlantic coast. The WC/ATWC is presently performing preliminary studies on U.S. Atlantic and Gulf coast hazard.